picture element to enable accurate and higher-quality image display.

[0020]

Although the display apparatus has also optical crosstalk that is induced by the wavelength dependency of the light transmissivity of the color filter, the leakage light from the polarization plate, etc., the present invention is intended to provide a crosstalk elimination circuit, a liquid crystal display apparatus, and a display control method that generate an LUT correction value of the crosstalk elimination circuit based on optical measurement result in consideration of the optical crosstalk to eliminate the electric and optical crosstalk in all the directions at the same time and to enable accurate and higher-quality image display.

MEANS FOR SOLVING THE PROBLEMS

[0021]

A first technical means is a crosstalk elimination circuit that corrects a display signal input to each of a plurality of picture element electrodes provided in a liquid crystal panel to eliminate crosstalk of a liquid crystal display apparatus using the liquid crystal panel, the circuit comprising an LUT that inputs a display signal of a correction target picture element and a display signal of an adjacent picture element adjacent to a source line of the correction target picture element in a certain vertical direction, the

LUT outputting a correction signal for correcting the display signal of the correction target picture element.

By correcting the display signal input to the target picture element electrode with the correction value extracted with the use of the LUT, the effect of the crosstalk generated between the picture element electrodes of the liquid crystal panel can be removed to display higher-quality images. Since the crosstalk correction value is extracted with the use of the LUT, the crosstalk can be corrected accurately under any conditions, unlike the disclosure of above patent document 2, for example, which only can correct crosstalk accurately under the certain condition that the picture element signal level of the same color is identical in the adjacent pixel.

[0022]

Although a crosstalk amount generally varies in accordance with the magnitude relationship between the display signal level of the correction target picture element and the display signal level of the adjacent picture element affecting the correction target picture element to generate the crosstalk, since this variation is nonlinear, a process efficiency is improved by using the LUT and costs can be reduced accordingly.

[0023]

A second technical means is the crosstalk elimination circuit of the first technical means wherein the adjacent picture element is a picture element adjacent to one of source lines disposed on both sides of the correction target picture

element electrode, which is not coupled via a switching element to the correction target picture element electrode.

Since the crosstalk is caused by the capacity coupling between the picture element electrode and the source line as described above, the crosstalk can be corrected faithfully by correcting the crosstalk with the use of the display signal level of another picture element capacitively coupled to the source line of the target picture element.

[0024]

A third technical means is the crosstalk elimination circuit of the first or second technical means wherein the LUT is disposed for each primary color of RGB to enable individual setup of the correction value of the LUT for each color.

That is, since the crosstalk amount is different for the picture element electrode of each primary color, the crosstalk can be corrected more faithfully by setting the correction data independently for each primary color. Since the optical crosstalk is also different for each primary color, the crosstalk can be corrected more faithfully by setting the correction data independently for each primary color.

[0025]

A fourth technical means is the crosstalk elimination circuit of any one of the first to third technical means wherein signal level intervals for setting the correction value data in the LUT are established roughly by a predetermined level width relative to a level width that may be achieved by the

signal level of the display signal input to each picture element electrode.

The LUT with a reduced circuit scale can be constructed by establishing the signal level intervals for setting the correction value data in the LUT roughly by the predetermined level width relative to the level width that may be achieved by the level of the display signal for each picture element. [0026]

A fifth technical means is the crosstalk elimination circuit of the fourth technical means wherein when extracting from the LUT the correction value data corresponding to the signal level between the signal levels with the correction value data set, the target correction value data are extracted by performing linear interpolation between the signal levels.

When using the LUT as in the fourth technical means, it is expected that the correction accuracy is reduced as compared to the level width that may be achieved by the level of the display signal for each picture element, and the crosstalk can be corrected more accurately by linearly interpolating the correction value between the roughly set levels to prevent the reduction in the correction accuracy. [0027]

A sixth technical means is the crosstalk elimination circuit of the fifth technical means wherein when the LUT is created by omitting regions where the correction value data are zero which are extracted with the use of the signal level

of the correction target picture element and the signal level of the adjacent picture element and when the linear interpolation is performed between a signal level having the correction value data of zero and a signal level set adjacently to the signal level, intended correction value data are extracted by performing the linear interpolation between the correction value data of the adjacently set signal level and fixed correction value data 0 defined in advance.

In the case of extracting the intended correction value data by linearly interpolating the correction value between levels set in the LUT as described in the fifth technical means, if the LUT is constituted with, for example, a level width of eight levels, which is set as the level width that may be achieved by the level of the display signal for each picture element, the LUT can store only 32 levels of the correction values and the interpolation cannot be performed with the endmost level. By setting the fixed value for the endmost data as described above, interpolation can be performed with the fixed value and it is not needed to construct a plurality of tables for the interpolation.

[0028]

A seventh technical means is the crosstalk elimination circuit of any one of the fourth to sixth technical means wherein the signal level intervals for setting the correction value data in the LUT are established with finer intervals of the signal levels of the correction target picture element as

compared to the signal levels of the adjacent picture element.

By establishing the signal level intervals for setting the correction value data in the LUT with finer intervals of the signal levels of the correction target picture element as compared to the signal levels of the adjacent picture element, the capacity scale of the LUT is reduced and the crosstalk can be corrected more flexibly and accurately.

[0029]

An eighth technical means is the crosstalk elimination circuit of any one of the first to seventh technical means further including an adjacent picture element correction LUT for correcting the display signal of the adjacent picture element adjacent to the correction target picture element, wherein the adjacent picture element correction LUT uses a display signal of a next adjacent picture element adjacent to a source line of the adjacent picture element in a certain vertical direction and the display signal of the adjacent picture element to extract correction value data of the adjacent picture element, which are output as an adjacent picture element correction signal, and wherein the LUT for correcting the correction target picture element inputs the display signal of the adjacent picture element corrected with the use of the signal output from the adjacent picture element correction LUT and the display signal of the correction target picture element to extract the correction data of the correction target picture element.

In crosstalk correction, if the crosstalk flows from right to left in the horizontal direction of the screen, the crosstalk must be corrected sequentially from the rightmost picture element on the screen in a relay mode. However, since a real time process is difficult and is not practical in this method, the crosstalk can be corrected with the same accuracy as the relay mode by correcting the adjacent picture element from the next adjacent picture element and correcting the correction target picture element from the corrected adjacent picture element.

[0030]

A ninth technical means is the crosstalk elimination circuit of the eighth technical means wherein signal level intervals for setting the correction value data in the adjacent picture element correction LUT are established more roughly than the signal level intervals for setting the correction value data in the LUT for correcting the correction target picture element.

Although a doubled LUT is needed and the circuit scale is increased if the LUT has a two-stage configuration as described in the eighth technical means, since the correction value may not be very strict when the adjacent picture element is corrected, a first stage LUT for correcting the adjacent picture element can be set more roughly than a second stage LUT for correcting the target picture element. This can constrain the negative effect increasing the circuit scale.

[0031]

A tenth technical means is a liquid crystal display apparatus provided with the crosstalk elimination circuit of any one of the first to ninth technical means.

Since the aforementioned crosstalk elimination circuit is disposed, the liquid crystal display apparatus can be realized which can correct the crosstalk accurately.

[0032]

An eleventh technical means is a liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying voltages to the picture element electrodes and by retaining this electric charge for one frame period, the apparatus comprising a correcting means that corrects a display signal input to each picture element electrode, the correcting means correcting the display signal to be input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of the display signals input to picture element electrodes arranged along the source line of the picture element electrode and the display signals input to picture element electrodes arranged along the source line of the adjacent picture element electrodes adjacent to the source line of the picture element electrode in the vertical direction.

Since the crosstalk is generated because the quantity of the electric charge applied to the picture element electrode is changed by the changes in the electric potentials of the source line of the picture element electrode and the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to the picture element electrodes arranged along the source line of the picture element electrode and the display signals input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction to correct the display signal to be input to the picture element electrode.

[0033]

A twelfth technical means is the liquid crystal display apparatus of the eleventh technical means wherein the correcting means generates a correction signal for the display signal to be input to the picture element electrode with the use of the display signals to be input to picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction,

and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and in consideration of a relationship among the level of the display signal to be input to the picture element electrode, the levels of the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode, and the levels of the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode, the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode, and the display signals to be

input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

[0034]

A thirteenth technical means is the liquid crystal display apparatus of the eleventh technical means wherein the correcting means corrects the display signal to be input to the picture element electrode during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Since the crosstalk is generated because the quantity of the electric charge formed by applying a voltage to the picture element electrode is changed by the change in the electric potential of the source line for the supply to other picture element electrodes during a period after the voltage is applied to the picture element electrode, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to other picture element electrodes during a period after the display signal is input to the picture element electrode to correct the display signal to be input to the picture element electrode.

[0035]

A fourteenth technical means is the liquid crystal display apparatus of the twelfth technical means wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes during a period after the timing when the display signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal to be input to the picture element electrode and the levels of the display signals to be input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode and the display signals to be input to other picture element electrodes.

[0036]

A fifteenth technical means is the liquid crystal display apparatus of the eleventh technical means wherein the correcting means corrects the display signal to be input to the picture element electrode during a period before the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Although the crosstalk cannot be completely corrected by this configuration as compared to the thirteenth technical means, a frame memory can be reduced and a circuit scale can be reduced by performing the correction with the use of the input display signals during a period before a display signal is input to a picture element electrode.

For example, in the case of TV (television receiver), etc., high-band components of the input image are filtered in advance; no problem occurs when considering that an entire screen is substantially uniform; a difference of image signals is small between frames (inter-frame correlation is high); especially, sensitivity to color difference is low in the characteristics of the human visual sense; and, therefore, no practical problem occurs when the input signals of a period before a display signal is input to a picture element electrode are used instead of the display signals input during a period

after the display signal is input to the picture element electrode in the thirteenth technical means.

Therefore, while the circuit scale is reduced, a liquid crystal display apparatus can be realized which can achieve the correction effect substantially equivalent to the case that the correction is performed with the use of the display signals input to other picture element electrodes during a period after the display signal is input to the picture element electrode as described in the thirteenth technical means.

[0037]

A sixteenth technical means is the liquid crystal display apparatus of the twelfth technical means wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period before the timing when the display signal should be input to the picture element electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to display signals input to other picture element electrodes during a period before the timing when the display

signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal to be input to the picture element electrode and the levels of display signals input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode and the display signals input to other picture element electrodes.

[0038]

A seventeenth technical means is a crosstalk elimination circuit of a liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying voltages to the picture element electrodes and by retaining this electric charge for one frame period, the apparatus comprising a correcting means that corrects a display signal input to each picture element electrode, the correcting means correcting the display signal to be input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of display signals input to picture element electrodes arranged along the source line of the picture element electrode and display signals input to picture element electrodes arranged along the source line of an adjacent picture element electrode adjacent to the source

line of the picture element electrode in the vertical direction.

Since the crosstalk is generated because the quantity of the electric charge formed by applying a voltage to the picture element electrode is changed by the change in the electric potential of the source line of the picture element electrode and the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to picture element electrodes arranged along the source line of the picture element electrode and the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction to correct the display signal to be input to the picture element electrode. [0039]

An eighteenth technical means is the crosstalk elimination circuit of the seventeenth technical means wherein the correcting means generates a correction signal for the display signal to be input to the picture element electrode with the use of the display signals to be input to the picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the

source line of the picture element electrode in the vertical direction and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and in consideration of a relationship between the level of the display signal to be input to the picture element electrode, the levels of the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode, the display signals to be input to other picture element electrodes arranged along the source line of the picture

element electrode and the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

[0040]

A nineteenth technical means is the crosstalk elimination circuit of the seventeenth technical means wherein the correcting means corrects the display signal to be input to the picture element electrode during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Since the crosstalk is generated because the quantity of the electric charge formed by applying a voltage to the picture element electrode is changed by the change in the electric potential of the source line for the supply to other picture element electrodes during a period after the voltage is applied to the picture element electrode, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to other picture element electrodes during a period after a display signal is input to a picture element electrode to correct the

display signal to be input to the picture element electrode.

[0041]

A twentieth technical means is the crosstalk elimination circuit of the eighteenth technical means wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes during a period after the timing when the display signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal to be input to the picture element electrode and the levels of the display signals to be input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode and the display signals to be input to other picture element electrodes.

[0042]

A twenty-first technical means is the crosstalk elimination circuit of the seventeenth technical means wherein the correcting means corrects the display signal to be input to the picture element electrode during a period before the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Although the crosstalk cannot be completely corrected by this configuration as compared to the nineteenth technical means, a frame memory can be reduced and a circuit scale can be reduced by performing the correction with the use of the input display signals during a period before the display signal is input to the picture element electrode.

For example, in the case of TV (television receiver), etc., high-band components of the input image are filtered in advance; no problem occurs when considering that an entire screen is substantially uniform; a difference of image signals is small between frames (inter-frame correlation is high); especially, sensitivity to color difference is low in the characteristics of the human visual sense; and, therefore, no practical problem occurs when the input signals of a period before the display signal is input to the picture element

electrode are used instead of the display signals input during a period after the display signal is input to the picture element electrode in the nineteenth technical means.

Therefore, while the circuit scale is reduced, a crosstalk elimination circuit can be realized which can achieve the correction effect substantially equivalent to the case that the correction is performed with the use of the display signals input to other picture element electrodes during a period after the display signal is input to the picture element electrode as described in the nineteenth technical means.

[0043]

A twenty-second technical means is the crosstalk elimination circuit of the eighteenth technical means wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period before the timing when the display signal should be input to the picture element electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals input to other picture element electrodes during a period before the timing when the

display signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal to be input to the picture element electrode and the levels of the display signals input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode and the display signals input to other picture element electrodes.

[0044]

A twenty-third technical means is a display control method of a liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying voltages to the picture element electrodes and by retaining this electric charge for one frame period, the method including a correcting step of correcting a display signal input to each picture element electrode, at the correcting step, the display signal to be input to the picture element electrode being corrected such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of display signals input to picture element electrodes arranged along the source line of the picture element electrode and display signals input to picture element electrodes arranged along the source line of an

adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

Since the crosstalk is generated because the quantity of the electric charge formed by applying a voltage to the picture element electrode is changed by the change in the electric potential of the source line of the picture element electrode and the source line of an adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to picture element electrodes arranged along the source line of the picture element electrode and the display signals input to picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction to correct the display signal to be input to the picture element electrode.

[0045]

A twenty-fourth technical means is the display control method of the twenty-third technical means wherein at the correcting step, a correction signal for the display signal to be input to the picture element electrode is generated with the use of the display signals to be input to the picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the

picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and in consideration of a relationship between the level of the display signal to be input to the picture element electrode, the levels of the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode,

the display signals to be input to other picture element electrodes arranged along the source line of the picture element electrode and the display signals to be input to other picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

[0046]

A twenty-fifth technical means is the display control method of the twenty-third technical means wherein at the correcting step, the display signal to be input to the picture element electrode is corrected during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Since the crosstalk is generated because the quantity of the electric charge formed by applying a voltage to the picture element electrode is changed by the change in the electric potential of the source line for the supply to other picture element electrodes during a period after the voltage is applied to the picture element electrode, the crosstalk can be eliminated more accurately and higher-quality images can be displayed by monitoring the display signals input to other

picture element electrodes during a period after the display signal is input to the picture element electrode to correct the display signal to be input to the picture element electrode.

[0047]

A twenty-sixth technical means is the display control method of the twenty-fourth technical means wherein at the correcting step, the correction signal for the display signal to be input to the picture element electrode is generated during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element electrode due to the display signals to be input to other picture element electrodes during a period after the timing when the display signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal to be input to the picture element electrode and the levels of the display signals to be input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture

element electrode and the display signals to be input to other picture element electrodes.

[0048]

A twenty-seventh technical means is the display control method of the twenty-third technical means wherein at the correcting step, the display signal to be input to the picture element electrode is corrected during a period before the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

Although the crosstalk cannot be completely corrected by this configuration as compared to the twenty-fifth technical means, a frame memory can be reduced and a circuit scale can be reduced by performing the correction with the use of the input display signals during a period before the display signal is input to the picture element electrode.

For example, in the case of TV (television receiver), etc., high-band components of the input image are filtered in advance; no problem occurs when considering that an entire screen is substantially uniform; a difference of image signals is small between frames (inter-frame correlation is high); especially, sensitivity to color difference is low in the characteristics of the human visual sense; and, therefore, no

practical problem occurs when the input signals of a period before the display signal is input to the picture element electrode are used instead of the display signals input during a period after the display signal is input to the picture element electrode in the twenty-fifth technical means.

Therefore, while the circuit scale is reduced, a display control method can be realized which can achieve the correction effect substantially equivalent to the case that the correction is performed with the use of the display signals input to other picture element electrodes during a period after the display signal is input to the picture element electrode as described in the twenty-fifth technical means.

[0049]

A twenty-eighth technical means is the display control method of the twenty-fourth technical means wherein at the correcting step, the correction signal for the display signal to be input to the picture element electrode is generated during a period before the timing when the display signal should be input to the picture element electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

The crosstalk can be corrected more accurately by configuring a computing equation or LUT for obtaining a crosstalk correction amount in consideration of a degree of change in the display luminance of the picture element

electrode due to display signals input to other picture element electrodes during a period before the timing when the display signal should be input to the picture element electrode and in consideration of a relationship between the level of the display signal input to the picture element electrode and the levels of display signals to be input to other picture element electrodes on this occasion and by obtaining the correction signal for the picture element electrode from the display signal to be input to the picture element electrode and the display signals input to other picture element electrodes.

[0050]

[0051]

[0052]

EFFECT OF THE INVENTION

[0053]

The present invention can effectively remove the crosstalk generated among the picture element electrodes arranged in horizontal, vertical, and oblique directions relative to the source line, the crosstalk due to the effect of the display signal input to other picture element electrodes during one future frame period after the display signal is input to the target picture element electrode, the optical crosstalk, etc., in the active matrix type liquid crystal display apparatus and can display accurate and higher-quality images.

[0054]

CLAIMS

1. (Amended) A crosstalk elimination circuit that corrects a display signal input to each of a plurality of picture element electrodes provided in a liquid crystal panel to eliminate crosstalk of a liquid crystal display apparatus using the liquid crystal panel, the circuit comprising:

an LUT that inputs a display signal of a correction target picture element and a display signal of an adjacent picture element adjacent to a source line of the correction target picture element in a certain vertical direction, the LUT outputting a correction signal for correcting the display signal of the correction target picture element.

2. (Amended) The crosstalk elimination circuit as defined in claim 1, wherein the adjacent picture element is a picture element adjacent to one of source lines disposed on both sides of the correction target picture element electrode, which is not coupled via a switching element to the correction target picture element electrode.

3. (Amended) The crosstalk elimination circuit as defined in claim 1 or 2, wherein the LUT is disposed for each primary color of RGB to enable individual setup of the correction value of the LUT for each color.

4. (Amended) The crosstalk elimination circuit as defined in any one of claims 1 to 3, wherein signal level intervals for setting correction value data in the LUT are established roughly by a predetermined level width relative to a level width that may be achieved by the signal level of the display signal input to each picture element electrode.

5. (Amended) The crosstalk elimination circuit as defined in claim 4, wherein when extracting from the LUT the correction value data corresponding to the signal level between the signal levels with the correction value data set, the target correction value data are extracted by performing linear interpolation between the signal levels.

6. (Amended) The crosstalk elimination circuit as defined in claim 5, wherein when the LUT is created by omitting regions where the correction value data are zero which are extracted with the use of the signal level of the correction target picture element and the signal level of the adjacent picture element and when the linear interpolation is performed between a signal level having the correction value data of zero and a signal level set adjacently to the signal level, the target correction value data are extracted by performing the linear interpolation between the correction value data of the adjacently set signal level and fixed correction value data 0 defined in advance.

7. (Amended) The crosstalk elimination circuit as defined in any one of claims 4 to 6, wherein the signal level intervals for setting the correction value data in the LUT are established with finer intervals of the signal levels of the correction target picture element as compared to the signal levels of the adjacent picture element.

8. (Amended) The crosstalk elimination circuit as defined in any one of claims 1 to 7, further including an adjacent picture element correction LUT for correcting the display signal of the adjacent picture element adjacent to the correction target picture element, wherein the adjacent picture element correction LUT uses a display signal of a next adjacent picture element adjacent to a source line of the adjacent picture element in a certain vertical direction and the display signal of the adjacent picture element to extract correction value data of the adjacent picture element, which are output as an adjacent picture element correction signal, and wherein the LUT for correcting the correction target picture element inputs the display signal of the adjacent picture element corrected with the use of the signal output from the adjacent picture element correction LUT and the display signal of the correction target picture element to extract the correction data of the correction target picture element.

9. (Amended) The crosstalk elimination circuit as defined in claim 8, wherein signal level intervals for setting the correction value data in the adjacent picture element correction LUT are established more roughly than the signal level intervals for setting the correction value data in the LUT for correcting the correction target picture element.

10. (Amended) A liquid crystal display apparatus provided with the crosstalk elimination circuit as defined in any one of claims 1 to 9.

11. (Amended) A liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying voltages to the picture element electrodes and by retaining this electric charge for one frame period, the apparatus comprising a correcting means that corrects a display signal input to each picture element electrode, the correcting means correcting the display signal to be input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of display signals input to picture element electrodes arranged along the source line of the picture element electrode and display signals input to

picture element electrodes arranged along the source line of an adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

12. (Amended) The liquid crystal display apparatus as defined in claim 11, wherein the correcting means generates a correction signal for the display signal to be input to the picture element electrode with the use of the display signals to be input to the picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and the display signal to be input to the picture element electrode.

13. (Amended) The liquid crystal display apparatus as defined in claim 11, wherein the correcting means corrects the display signal to be input to the picture element electrode during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

14. (Amended) The liquid crystal display apparatus as defined in claim 12, wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

15. (Amended) The liquid crystal display apparatus as defined in claim 11, wherein the correcting means corrects the display signal to be input to the picture element electrode during a period before the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

16. (Amended) The liquid crystal display apparatus as defined in claim 12, wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period before the timing when the display signal should be input to the picture element

electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

17. (Amended) A crosstalk elimination circuit of a liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying voltages to the picture element electrodes and by retaining this electric charge for one frame period, the apparatus comprising a correcting means that corrects a display signal input to each picture element electrode, the correcting means correcting the display signal to be input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of display signals input to picture element electrodes arranged along the source line of the picture element electrode and display signals input to picture element electrodes arranged along the source line of an adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

18. (Amended) The crosstalk elimination circuit as defined in claim 17, wherein the correcting means generates a correction signal for the display signal to be input to the

picture element electrode with the use of the display signals to be input to the picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and the display signal to be input to the picture element electrode.

19. (Amended) The crosstalk elimination circuit as defined in claim 17, wherein the correcting means corrects the display signal to be input to the picture element electrode during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

20. (Amended) The crosstalk elimination circuit as defined in claim 18, wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element

electrode and the display signal to be input to the picture element electrode.

21. (Amended) The crosstalk elimination circuit as defined in claim 17, wherein the correcting means corrects the display signal to be input to the picture element electrode during a period before the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

22. (Amended) The crosstalk elimination circuit as defined in claim 18, wherein the correcting means generates the correction signal for the display signal to be input to the picture element electrode during a period before the timing when the display signal should be input to the picture element electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

23. (Amended) A display control method of a liquid crystal display apparatus that uses an active matrix type liquid crystal panel with a plurality of picture element electrodes formed in a matrix shape to display color images by applying

voltages to the picture element electrodes and by retaining this electric charge for one frame period, the method including a correcting step of correcting a display signal input to each picture element electrode, at the correcting step, the display signal to be input to the picture element electrode being corrected such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of display signals input to picture element electrodes arranged along the source line of the picture element electrode and display signals input to picture element electrodes arranged along the source line of an adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction.

24. (Amended) The display control method as defined in claim 23, wherein at the correcting step, a correction signal for the display signal to be input to the picture element electrode is generated with the use of the display signals to be input to the picture element electrodes arranged along the source line of the picture element electrode, the display signals to be input to the picture element electrodes arranged along the source line of the adjacent picture element electrode adjacent to the source line of the picture element electrode in the vertical direction and the display signal to be input to the picture element electrode.

25. (Amended) The display control method as defined in claim 23, wherein at the correcting step, the display signal to be input to the picture element electrode is corrected during a period after the display signal is input to the picture element electrode such that the display luminance of the picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

26. (Amended) The display control method as defined in claim 24, wherein at the correcting step, the correction signal for the display signal to be input to the picture element electrode is generated during a period after the timing when the display signal should be input to the picture element electrode with the use of a display signal to be input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

27. (Amended) The display control method as defined in claim 23, wherein at the correcting step, the display signal to be input to the picture element electrode is corrected during a period before the display signal is input to the picture element electrode such that the display luminance of the

picture element has a color difference $\Delta E=6.5$ or less relative to the display luminance that should actually be displayed, regardless of a display signal input to a picture element electrode other than the picture element electrode.

28. (Amended) The display control method as defined in claim 24, wherein at the correcting step, the correction signal for the display signal to be input to the picture element electrode is generated during a period before the timing when the display signal should be input to the picture element electrode with the use of a display signal input to a picture element electrode other than the picture element electrode and the display signal to be input to the picture element electrode.

29. (Canceled)

30. (Canceled)

31. (Canceled)

32. (Canceled)